

AMENDMENTS TO THE DRAWINGS

The attached sheet of drawings includes changes to Figures 3 and 4. Figures 3 and 4 have been amended to include the legend "Prior Art."

Attachment: Replacement sheet

REMARKS

Reconsideration of the present application as amended is respectfully requested. Claims 1-7 have been amended. Claims 1-7 are currently pending.

The Office Action has indicated that Figures 3 and 4 should be designated by a legend such as --Prior Art-- because "only that which is old is illustrated." Applicants have submitted replacement sheets in which Figures 3 and 4 have been amended to include the legend "Prior Art" as requested. Applicant respectfully requests that the objection to the drawings be withdrawn.

Claim 1 has been objected to because it is indicated that it appears to contain a typographical error in line 3. The Office Action recommends that the claim be amended to change the term "characterised" to "characterized." Claim 1 as amended no longer includes the term "characterised." Applicant respectfully requests that the objection to claim 1 be withdrawn.

Claims 1-7 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which application regards as the invention. Regarding independent claim 1, the Office Action indicates that the limitation "A telecommunications/computer system" renders the claim indefinite. The Office Action asserts that "it is unclear what type of system the claim is intended to be." The Office Action recommends that the claim be amended to remove the term "telecommunications/computer" or specify one type or the other. Applicant has amended claim 1 to delete the term "telecommunications/computer." Applicant submits that claim 1 as amended adequately defines the subject matter of the invention. In particular, Applicant respectfully submits that the inclusion of the term "computing nodes" is sufficient to encompass both telecommunications and computer systems as described in the specification as falling within the scope of the invention.

Regarding claims 1 and 2, the Office Action indicates that the term "relatively small" is a relative term which renders the claims indefinite. Applicant has amended claims 1 and 2 to delete the term "relatively small." Nonetheless, Applicant respectfully submits that the standard for ascertaining what is meant by "relatively small number of cross-links" is sufficiently clear from the specification, and in particular in the discussion starting at page 6, line 11 to page 7,

line 14 of the specification. In particular, Applicant submits that it is clear that what is required is that a small number of cross-links are established such that the system has a high degree of clustering of nodes in combination with a low average path length between nodes, which combination is characteristic of a small-world network. For the sake of further clarity, Applicant has amended claim 1 to define the number of cross-links in terms of this small-world characteristic, in particular of "the cross-links being selected such that the system has a high degree of clustering of nodes in combination with a low average path length between nodes." Applicant submits that the scope of claims 1 and 2 as amended is clear to one of ordinary skill in the art, particularly in view of the aforementioned portions of the specification.

Regarding claim 2, the Office Action indicates that the limitation "relatively small number of connections" in line 1 lacks sufficient antecedent basis. In accordance with the Office Action's recommendations, Applicant has amended claim 2 to replace the term "connections" with "cross-links." Regarding claims 2 and 6, the Office Action indicates that the limitation "random links" is unclear. Applicant respectfully submits that it would be apparent to one of ordinary skill in the art that the term "random links" means that the cross-links provided between node clusters are selected at random. For the sake of further clarity, Applicant has amended claims 2 and 6 in accordance with this meaning.

Regarding claims 4 and 5, the Office Action indicates that the term "about" used in conjunction with numerical values renders claims 4 and 5 indefinite. Applicant has amended claims 4 and 5 to define the relevant ranges using more precise language. Regarding claim 7, the Office Action indicates that the Office Action indicates that the limitation "a small world principle" renders claim 7 indefinite. As indicated in the Office Action, page 5, line 10 of the specification makes reference to "the small world principle." As discussed in the specification the "small world principle" is an established principle in biological and social networks. To further clarify claim 7, claim 7 has been amended to indicate that a plurality of computing nodes interconnected according to the small world principle as "characterized by a high degree of clustering of nodes in combination with a low average path length between nodes." Support for these amendments may be found at at least page 6, line 11 to page 7, line 14 of the specification. In view of the foregoing, Applicant respectfully requests that the 35 U.S.C. 112, second paragraph rejections of claims 1-7 be withdrawn.

Claims 1-3 and 7 stand rejected under rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,602,839 to Annapareddy et al. ("Annapareddy"). Independent claim 1 as amended is directed to "a system comprising a plurality of computing nodes interconnected to form a plurality of node clusters, wherein cross-links are provided between said clusters, the cross-links being selected such that the system has a high degree of clustering of nodes in combination with a low average path length between nodes." Applicant respectfully submits that Annapareddy fails to teach or suggest the features of independent claim 1 as amended.

Figure 2 and column 5, lines 35-59 of Annapareddy describes a depiction of a multinode network. Although the multinode network depicted in Figure 2 of Annapareddy may appear superficially to bear a resemblance to the invention of independent claim 1, Applicant respectfully submits that Annapareddy fails to teach or suggest the features of independent claim 1 as claimed. Annapareddy is directed to an entirely different problem from that addressed by the invention of independent claim 1. In particular, Annapareddy describes a routing method and apparatus that is independent of network topology in order to solve problems with routing techniques that rely upon network topology. In the system of Annapareddy, the grouping of nodes depicted is an abstraction of the routing method, which does not necessarily correspond with any topological clustering of the nodes. Furthermore, in Annapareddy the interconnections between nodes in each group, as well as the interconnections between node groups, are not selected in order to achieve any particular result. Rather, the interconnections of Annapareddy are the result of the pre-existing network topology to which the routing method disclosed by Annapareddy is applied.

Additionally, even if it can be assumed that Figure 2 of Annapareddy is seen to represent nodes interconnected to form a plurality of node clusters, it is apparent that the cross-links between node groups do not result in the nodes being interconnected according to the small world principle characterized by a high degree of clustering of nodes in combination with a low average path length between nodes. On the contrary, Annapareddy illustrates for example, in Figure 2, that node n3 of group G1, node n3 of group G3 and node n1 of group G4 are as densely interconnected as the nodes within any of the individual groups, and accordingly that the depicted network has a far higher degree of cross-linking than would be the case if it had been

designed and constructed according to the small-world principle as found in the present invention of independent claim 1. In view of the foregoing, Application respectfully submits that Annapareddy fails to teach or suggest at least the feature of independent claim 1 of "cross-links being selected such that the system has a high degree of clustering of nodes in combination with a low average path length between nodes." Applicant respectfully submits that independent claim 1 distinguishes over Annapareddy and requests that the 35 U.S.C. 102(b) rejection of independent claim 1 be withdrawn.

Claims 2-3 are dependent upon and include the features of independent claim 1. For at least the reasons as discussed with respect to independent claim 1, Applicant respectfully submits that claims 2-3 also distinguish over Annapareddy and requests that the 35 U.S.C. 102(b) rejections of claim 2-3 be withdrawn.

Independent claim 7 as amended is directed to "A scalable computer system comprising a plurality of computing nodes interconnected according to the small world principle, whereby the system is characterized by a high degree of clustering of nodes in combination with a low average path length between nodes." For similar reasons as those discussed with respect to independent claim 1, Applicant respectfully submits that independent claim 7 distinguishes over Annapareddy and requests that the 35 U.S.C. 102(b) rejection of independent claim 7 be withdrawn.

Claims 4 and 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Annapareddy in view of U.S. Patent No. 5,859,975 to Brewer et al. ("Brewer"). It appears from the rejection description that it was intended to reject claims 4 and 5 under 35 U.S.C. 103(a) as being unpatentable over Annapareddy in view of Watts et al. ("Watts"). Accordingly, Applicant will address the rejections of claims 4 and 5 by discussing Annapareddy in view of Watts. Claim 4 as amended is directed to "the system of claim 1 wherein the average path length between nodes is less than 2.0." Claim 5 as amended is directed to "the system of claim 4, wherein the average path length between nodes is between 1.5 and 1.7."

Claims 4 and 5 are dependent upon and include the features of independent claim 1. The Office Action acknowledges that Annapareddy fails to disclose that "the mean connectivity between nodes of different neighborhoods is about 1.5 to 2.0, or, more specifically, 1.6." The

Office Action asserts that Watts teaches that "adjusting parameters of a small-world network results in changes in the characteristic path link" and "adding a few cross-links results in a large drop in the path length (Figure 2), while substantially maintaining the clustering of the network." The Office Action further asserts that it would have been merely a matter of preference to a designer of the system to adjust the parameters of the network to obtain any desired mean connectivity, such as 1.6."

Regarding claims 4 and 5, as discussed with respect to the rejection of independent claim 1, Annapareddy fails to teach or suggest the aforementioned distinguishing features of independent claim 1. Applicant respectfully submits that the cited combination of Annapareddy and Watts also fails to teach or suggest these features. Further, since Annapareddy does not teach or suggest a system constructed according to the small-world principle, including node clusters interconnected by cross-lengths selected such that the system has a high degree of clustering of nodes in combination with a low average path length between nodes as found in independent claim 1, Applicant respectfully submits that there is no motivation to be found in Annapareddy to lead one of ordinary skill in the art to combine its disclosure with that of Watts. Indeed, while Annapareddy is concerned with routing messages within a network in a manner that is independent of network topology, Watts is concerned with specific topologies arising in disparate fields, and in particular in biological and social systems.

Further, Applicant respectfully submits that it is not merely a matter of preference to adjust the parameters of a network in accordance with the invention of claims 4 and 5 in order to obtain an average path length of less than 2.0, and more particularly between 1.5 and 1.7. Rather these values have been specifically determined by the inventors of the present invention to be particularly advantageous in the implementation of highly scalable systems. In view of the foregoing, Applicant respectfully submits that claims 4 and 5 distinguish over Annapareddy in view of Watts and requests that the 35 U.S.C. 103(a) rejection of claims 4 and 5 be withdrawn.

Claims 6 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Annapareddy in view of Watts. It appears from the rejection description that it was intended to reject claim 6 under 35 U.S.C. 103(a) as being unpatentable over Annapareddy in view of U.S. Patent No. 5,859,975 to Brewer et al. ("Brewer"). Accordingly, Applicant will address the rejection of claim 6 by discussing Annapareddy in view of Brewer. Independent claim 6 as

amended is directed to "A large scale computer system including a multiplicity of nodes, each node having a plurality of interconnected processors, said nodes being arranged in a network with neighboring sets of nodes of the network forming clusters of fully interconnected nodes, wherein cross-links are provided between nodes of different clusters in the network, the cross-links being selected at random to provide a high degree of clustering of nodes in combination with a low average path length between nodes, whereby each processor of the system can communicate effectively with other processors regardless of their location in the network and without full connectivity in the network." For similar reasons as those discussed with respect to independent claim 1, Applicant respectfully submits that independent claim 6 distinguishes over Annapareddy.

The Office Action acknowledges that Annapareddy fails to disclose that each node has a plurality of interconnected processors. The Office Action asserts that column 1, lines 26-31 of Brewer discloses that "the use of multiple processors in a single node of a distributed system is well known in the art." As previously discussed, Annapareddy fails to teach or suggest the aforementioned distinguishing features of independent claim 6. Applicant respectfully submits that Brewer also fails to teach or suggest these features. In particular, Applicant respectfully submits that there is no teaching or suggestion in Annapareddy or Brewer of a large-scale computer system in which multi-processing nodes are arranged in a network to form clusters of fully interconnected nodes, with cross-links provided between the clusters that have been selected at random so as to provide a high degree of clustering of nodes in combination with a low average path length between nodes as found in independent claim 6 as amended. Applicant respectfully submits that independent claim 6 distinguishes over Annapareddy in view of Brewer and requests that the 35 U.S.C. 103(a) rejection of independent claim 6 be withdrawn.

In view of the above amendments, Applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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